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DISTRIBUTION OF THE FRESH-WATER FISHES OF MEXICO.

SETH EUGENE MEEK.

MEXICO consists of a high plateau bordered on each side by a narrow coastal plain. It lies between the United States and Central America, but is not separated from either by natural boundary lines. The southern half of this country lies in the torrid zone, the rest in the North Temperate. Its geographical position, its elevation and diversity of climate make it, from a biological standpoint, a most interesting country. The Rocky Mountains extend into the northern United States as a single range to the Yellowstone Park. Here is given off to the west the Wasatch range, which extends south into Mexico as the western range of the Sierra Madre. The Rocky Mountains proper become in Mexico the eastern range of the Sierra Madre. These two mountain ranges include a plateau, the elevation of which varies from three to eight thousand feet above the sea. This plateau is drained by four river systems:—the Colorado river on the north and west, the Rio Grande, central and eastern portion, the Rio Panuca and the Rio Lerma, the southern portion. The southern end of this plateau is the beautiful valley in which is built the City of Mexico, while the two mountain ranges culminate in the famous peaks of Ixtaccihuatl and Popocatepetl. The valley of Mexico though at one time it probably drained into the Lerma now comprises a drainage system of its own. The great central plateau comprises the larger part of Mexico. On the east and the west is a low narrow plain from which the ascent to the plateau is steep. South of the valley of Mexico the mountains extend as one range through Central America to become the Andes in South America. The Mexican plateau in general is a treeless plain, covered with only a slight vegetation.

The Yucca, the Mesquite, various species of Cacti, sage brush, a few stunted cedars and the like, together with a sparse growth of various species of grasses, comprise the larger part of the vegetation of this region. During the rainy season and a

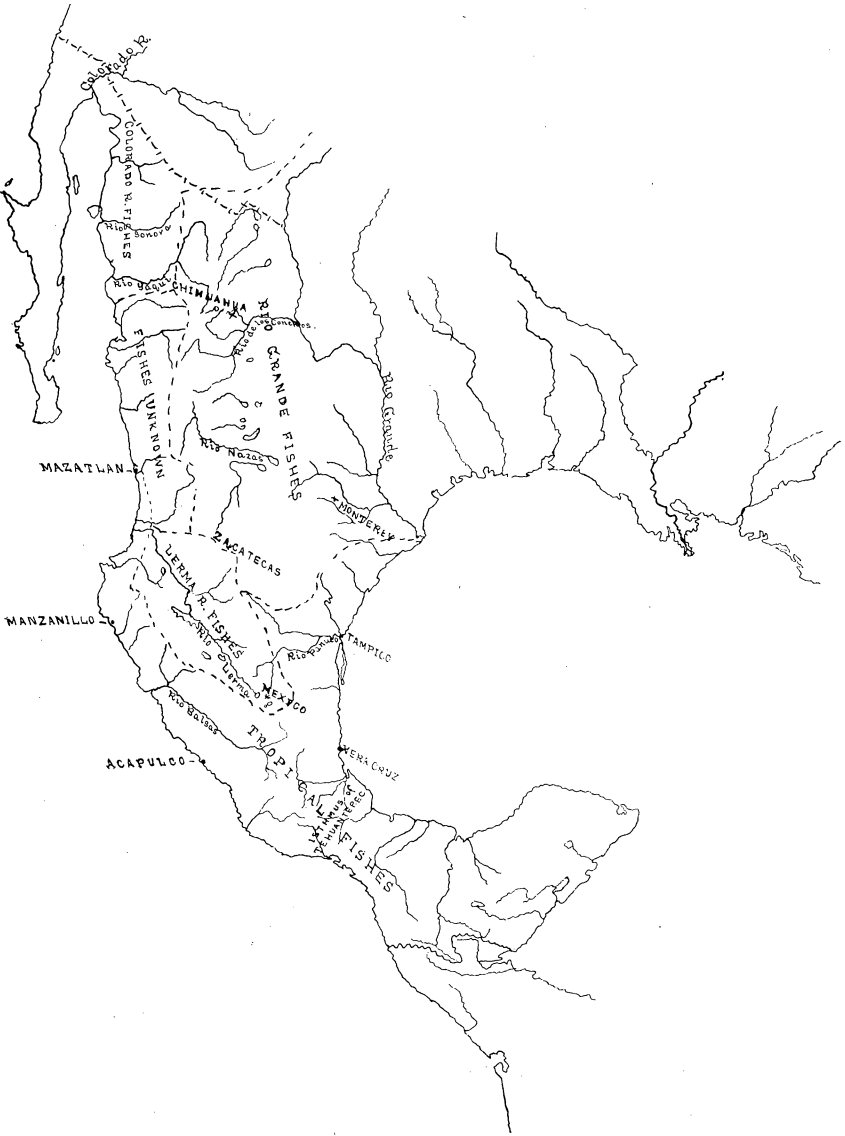
short time after it, there is a luxuriant growth of vegetation: but after a few months of exposure to the piercing rays of a tropical sun the character of the country changes, and it assumes the air of a parched desert. It is subject to a short rainy season and a long dry one. The rivers which are large in the rainy season become almost dry by the end of the long dry season. Many of the lakes in northern Mexico become dry and the streams which flow into them contain but little water except in the upper part of their courses where they are fed by mountain springs, and streams of this character contain but few species of fish.

The study of any group of plants or animals in a country like this is very interesting, but no group of living things presents a more interesting subject for the study of geographical distribution than the fresh water fishes. Living as they do in the water their only highways of travel are in the streams and lakes and so their dispersion is largely governed by the formation of our fresh water lakes and rivers and is therefore intimately associated with the later chapters of the geological history of the earth.

The two large rivers which reach Mexico from the north and which have furnished highways by which Northern Mexico became stocked with fishes are the Colorado and the Rio Grande. The former flows into the Gulf of California, the latter into the Gulf of Mexico. In their upper courses these two rivers are near each other, but their fishes are not the same. The only fish common to both river basins is a small dace (*Rhinichthys dulcis*) and this is also found in the head waters of the Arkansas, the Missouri and the Columbia rivers. From the Colorado river there are known 32 species of fishes which are distributed in 18 genera and 5 families.¹ Of these 32 species all but 10² are thus far known only from this basin. Nine of

¹ Catostomidæ (Suckers) 9 species, Cyprinidæ (Minnows) 18 species, Salmonidæ (Trout and White fishes) 2 species, Poecilidæ (Killifishes) 2 species, Cottidæ (Blobs) 1 species.

² *Leuciscus lineatus* (Girard), *Rhinichthys dulcis* (Girard), *Agosia chrysogaster* Girard, *Agosia oscula* (Girard), *Lepidomeda vittata* Cope, *Coregonus williamsoni* Girard, *Salmo spilurus* (Cope), *Poecilia occidentalis* (Baird & Girard), *Cottus punctulatus* (Gill).



Map of Mexico showing fish faunal areas.

these exceptions belong to other western streams, the other species (*Rhinichthys dulcis*) is found in all rivers whose sources are in the Rockies. Of the 18 genera 4¹ are thus far known only from the Colorado basin.

More than half of the Colorado fishes are minnows (Cyprinidæ), and of these the white salmon (*Ptychocheilus lucius* Girard) is the largest member of the family. In the Colorado River specimens of this species are occasionally taken which reach a weight of 80 pounds. The blob (*Cottus punctulatus*) is the only spiny-rayed fish known from this basin.

Up to within the past year and a half very little was known concerning the fishes of the Rio Yaqui, the largest river in Northwestern Mexico. The few fishes previously taken in that river indicated that its fauna was that of the Colorado. The finding of a bull-head in this basin in 1896 seemed a little strange and it was difficult to account for its presence there. With these facts in mind, when I was collecting fishes in Chihuahua it was with no small amount of interest that I visited Lago de Castillos which is a part of a small river basin between the head waters of the Rio Conchos and the Rio Yaqui. At Castillos I found only the Rio Grande chub. In the Yaqui I also found this chub, and a number of species I had taken in tributaries of the Rio Grande, at Chihuahua, and San Andres.

Of 14² species known from the Rio Yaqui, 9 (listed below in bold type) have been taken in the Rio Grande basin, 2³ have been found nowhere else; one of these (*Gila minacæ*) belongs to a genus peculiar to the Colorado river basin, the other (*Catostomus sonorensis*) belongs to a genus well represented in both the Colorado and Rio Grande. Of the remaining 3 species 2 (*Agosia chrysogaster* and *Pacilia occidentalis*) belong to the Colorado river fauna. In the lower portion of the Rio Sonora

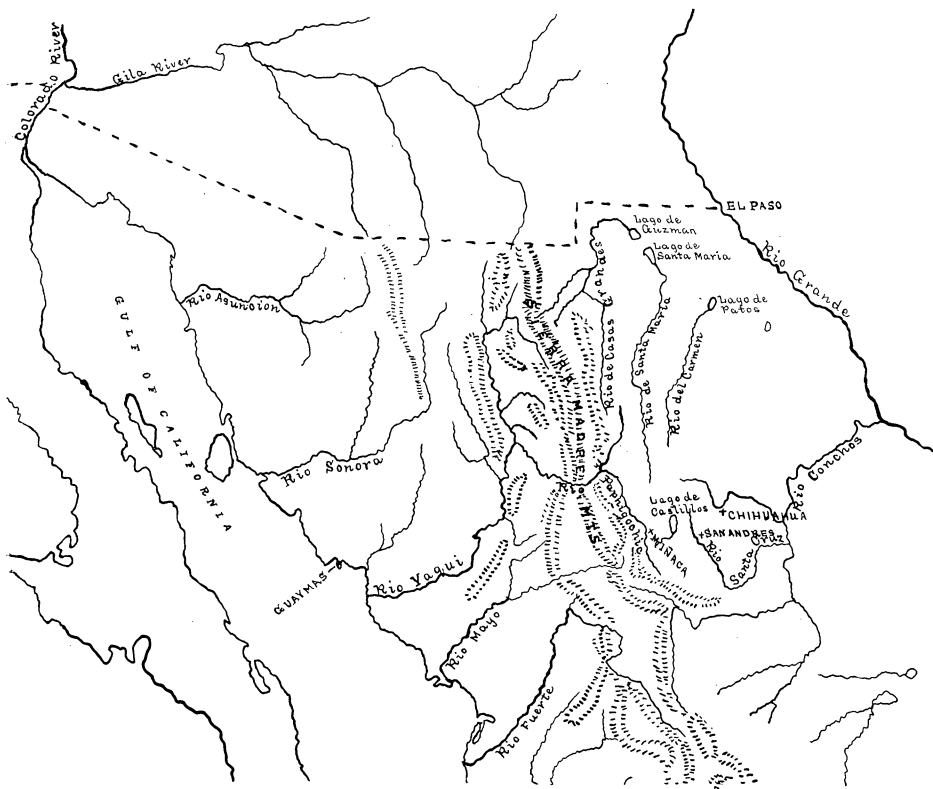
¹ Xyrauchen, Tiaroga, Meda, Plagopterus.

² *Ameiurus pricei* (Rutter), *Pantosteus plebius* (B. & G.), *Catostomus bernardini* Girard, *Camptostoma ornatum* Girard, *Pimephales confertus* (Girard) *Gila minacæ* Meek, *Leuciscus nigrescens* (Girard), *Notropis ornatus* (Girard), *Notropis lutrensis* (B. & G.) *Agosia chrysogaster* Girard, *Salmo spilurus* Cope, *Cyprinodon elegans* (B. & G.) *Pacilia occidentalis* B. & G.

³ *Catostomus bernardini* and *Gila minacæ*.

3 or 4¹ species which belong to the Colorado river fauna have been taken.

The presence of so many fishes from the Rio Grande basin can be thus interpreted:—The head waters of the Rio Paphigochic, a tributary of the Rio Yaqui, lie east of the central



Map showing head waters of the Rio Yaqui and a western tributary of the Rio Grande.

range of the Sierra Madre mountains. That portion of this stream no doubt formerly had its outlet through Lago de Castillos into the Rio Conchos and in this way became stocked with fishes from the Rio Grande.² The fact that the fauna of the

¹ *Catostomus bernardini* Girard, *Phychocheilus lucius* Girard, *Agosia oscula* (Girard), *Pacilia occidentalis* (Baird & Girard).

² A collection of fishes was made recently by the writer in the Rio Mezquital at Durango. This collection has not yet been studied; it is however composed largely of Rio Grande species.

Rio Yaqui is so much like that of the isolated river basins in northern Mexico rather strengthens this belief, though its ultimate proof must depend on the geologist.

In Northern Chihuahua west of the Rio Grande and adjacent to the head waters of the Gila river, the Rio Yaqui and the Rio Conchos, there is a considerable area which is drained by several small river systems, all of which have no outlets. Five of these small basins have been examined as follows: the Rio Carmen which drains into Lago de Patos, the Rio Santa Maria which drains into Lago de Santa Maria, the Rio Casas Grande which drains into Lago de Guzman, the Rio Castillos which drains into Lago de Castillos, and a small stream at Sauz, in the state of Chihuahua. During the rainy season the water collects in the lowest portion of these valleys forming large lakes. Most of these lakes become quite or entirely dry by the end of the dry season, but there is always enough water in the upper courses of the rivers which flow into them to sustain a considerable number of fishes. All of these streams were at one time a portion of the Rio Grande. These five basins have not been equally explored, though it is likely that all have about the same fauna. From these basins have been taken 10 species¹ of fishes.

Of these 10 species none has been recorded from the Gila river or the Rio Sonora. All except 3 (*listed in bold type*) are reported from the headwaters of the Rio Yaqui in Chihuahua, and from the Rio Conchos. The three exceptions are species closely related to *Notropis lutrensis*, an extremely variable and widely distributed minnow, and which is abundant in both of these rivers. One other minnow (*Notropis ornatus*) is

¹ *Pantosteus plebeius* (B. & G.). Casas Grandes; Rio Carmen; Sauz.

Compostoma ornatum Girard. Casas Grandes.

Pimephales confertus Girard. Casas Grandes; Santa Maria.

Leuciscus nigrescens (Girard). Casas Grandes; Santa Maria; Carmen Castillos; Sauz.

Notropis frigidus Girard. (Identification doubtful), Santa Maria.

Notropis santamariæ Evermann & Goldsborough. Santa Maria.

Notropis formosus Girard. Casas Grandes.

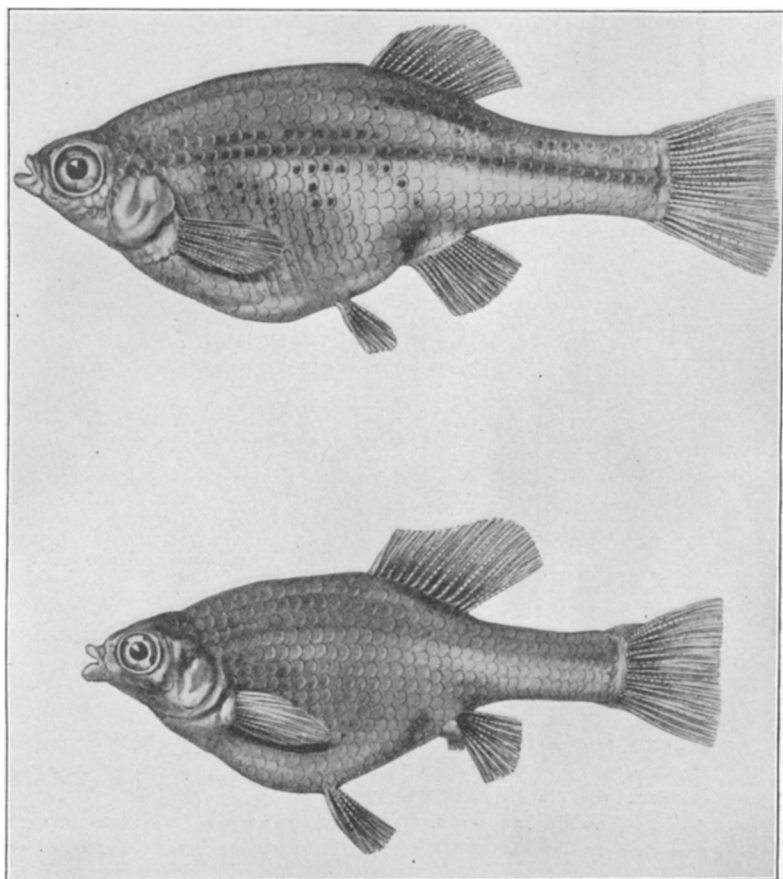
Notropis lutrensis (B. & G.). Casas Grandes; Santa Maria; Carmen; Sauz.

Cyprinodon elegans (B. & C.). Casas Grandes; Santa Maria; Carmen.

Gambusia affinis (Baird & Girard). Sauz.

common to both the Rio Conchos and Rio Yaqui, but at present is not known from any of the four small river basins. No other species than those here mentioned is known to be common to the Rio Yaqui and Rio Conchos.

Aside from the five small river basins mentioned above there



Skiffia ermæ Meek, ♀.

Skiffia lermæ Meek, ♂.

are in central Mexico several others with no outlet to the sea, of which the Rio Nazas is the largest. From a number of these no collections of fishes have been made, though their fishes so

far as known are that of the Rio Grande. From the Rio Nazas are known 12¹ species of fishes, 6 of these (listed in bold type) have been taken in the Rio Grande or its tributaries, all of the others except *Stypodon signifer* and *Characodon garmani*, belong to genera well represented in the Rio Grande. The genus *Stypodon* is known only from the Rio Nazas, and *Characodon* is a tropical genus. Every large lake or river, as a rule, contains one or more species of fishes not found in other localities.

It is evident that the larger number of the Rio Grande fishes have migrated directly or indirectly from the Mississippi valley, 23 of its 85 species being found in the Wabash in Indiana. This fauna has crowded its way over the divide and has become more firmly established in the Pacific coast streams of Sonora than has the Colorado river fauna, and one species (*Notropis nigrotæniatus*) at least has gotten as far south as the Rio Balsas in southern Mexico.

The southern portion of the Mexican plateau is drained by two rivers: the one to the east, the San Juan del Rio, is a small stream which flows into the Rio Panuco. The other, the Lerma, flows into the Pacific. The Lerma is the longest river in Mexico. The valley of Mexico was formerly a part of the Lerma drainage system. The fish fauna of this region is very different from that either to the north or the south. From the area which includes the valley of Mexico,² the head waters of the San Juan del Rio³ and the Lerma basin, are known at present 49 species of fishes, not one of which is known to occur

¹ *Ameiurus prici* Rutter, *Carpiodes tumidus* Girard, *Pantosteus nebuliferus* (Garman), *Hybognathus punctifer* Garman, *Stypodon signifer* Garman, ***Leuciscus nigrescens*** (Girard), ***Leuciscus modesta*** (Garman), *Notropis garmani* Jord. & Ev., *Rhinichthys simus* Garman, *Cyprinodon latifasciatus* Garman, *Characodon garmani* Jordan & Evermann, ***Etheostoma pottsii*** (Girard), ***Etheostoma australe*** Jordan.

² The following is a list of the fishes known from the Valley of Mexico, those printed in bold type are peculiar to this region.

Algansea tincella (C. & V.), ***Aztecula azteca*** (Woolman), ***Evarra eigenmani*** Woolman, ***Evarra tlahuacensis*** Meek, *Girardinichthys innominatus* Bleeker, *Zoogoneticus miniatus* Meek, ***Skiffia variegata*** Meek, *Chirostoma jordani* Woolman, *Chirostoma humboldtianum* (C. & V.), *Chirostoma estor* Jordan.

³ List of species known from the headwaters of the San Juan del Rio.

Algansea tincella, ***Aztecula mexicana***, *Goodea caliente*.

in any other river. These 49 species belong to 17¹ genera, 10 of which are peculiar to this region.

Of the genera found elsewhere, *Characodon* is represented in southern Mexico, central America, and lower California. *Gambusia* comprises a number of small viviparous fishes usually inhabiting swamps and springs all the way from Southern Illinois to Panama. The other five genera, *Lampetra*, *Ameiurus*, *Moxostoma*, *Notropis* and *Hybopsis* are northern genera, and all except *Notropis* are not represented by any species farther south than the Rio Lerma. Of the 49 species found in this region, 33 belong to two families; 17 to *Poeciliidæ* (the Killifishes) and 16 to *Atherinidæ* (the Silversides). It is curious to note here that all of the killifishes are viviparous, yet only one species, *Gambusia infans* Woolman, has the anal fin of the male placed well forward and modified into an intromittent organ such as is characteristic of *Heterandria*, *Poecilia* and the like. In the other 15 species the anal fin of the male has its normal position and size. It is slightly modified by the shortening of the first five or six rays, and their slight separation from the rest of the fin by a shallow notch. This modification was first noticed by Günther in *Characodon lateralis* Gunther. It was also described by Bean in *Zoogoneticus robustus* (Bean), and by Jordan and Snyder in *Goodea caliente* J. & S. but no significance was attached to it. Just what part this fin plays in fertilizing the eggs in the body of the female is not known, but it evidently plays a prominent part in this operation.

I was fortunate to collect these fishes during the breeding season and so their viviparity was easily proved. The largest killifish known from the Lerma Basin reaches a length of 8 or 10 inches. The accompanying figures are made from a photograph of the largest female of this species I was able to obtain. It was purchased from a fisherman who did not suppose it would find its way into a distant museum and this explains its rather dilapidated appearance. The ovary consists of a membranous

¹ The genera in italics are peculiar to this region.

Lampetra 1, *Ameiurus* 1, *Moxostoma* 1, *Algansea* 4, *Aztecula* 3, *Notropis* 1, *Xystrosus* 1, *Evarra* 2, *Falcula* 1, *Hybopsis* 1, *Zoogoneticus* 5, *Girardinichthys* 1, *Characodon* 2, *Chapalichthys* 2, *Gambusia* 1, *Goodea* 7, *Chirostoma* 16.

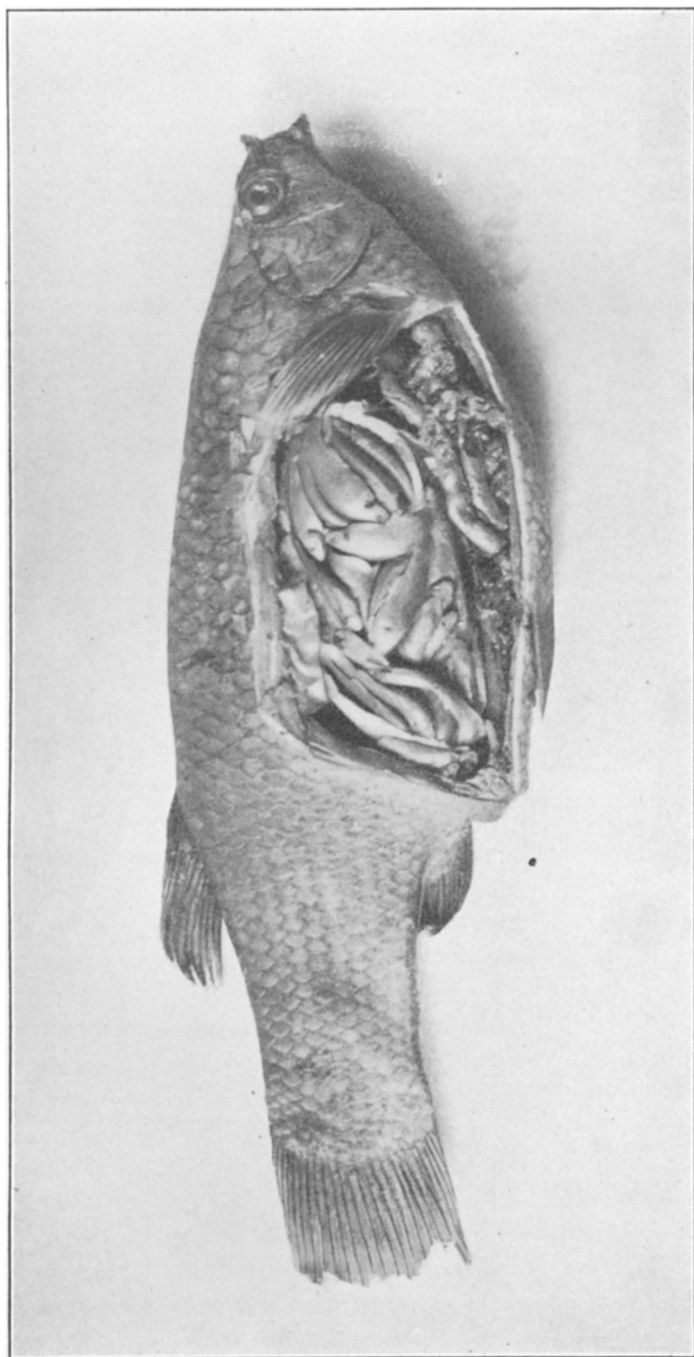
sack with a number of infolded partitions. Removing a portion of one side shows the ovary full of quite well developed young. The little fishes in it are not arranged in any definite order.

The spawning time for these fishes is near the close of the dry season. At this time the water is more concentrated, as is also the food on which the young must feed. The aquatic insects, crustaceans and small fishes which would feast on the eggs if deposited then are also more concentrated, so that depositing the eggs at this time would mean considerable destruction to the species. As it is, the young are born in a well developed stage, and have time to reach some size before the wet season sets in. They are then perhaps in the best condition to become widely distributed as the volume and area of water increases. As the dry season approaches again, and small streams and ponds become dry, many of these small fishes perish. They are, however, present everywhere to establish themselves in every body of water which may carry them through to the next rainy season.

The gestation of many tropical fishes presents some strange peculiarities. Some of the catfishes carry the eggs in the mouth till hatched, while a few others are thought to be viviparous. Viviparity among the tropical killifishes in general seems to be the rule rather than the exception. It would seem that in the tropical fresh waters of America, there is much more provision made for the care of the young than in the cooler waters of the Northern continent.

It was rather surprising to find such a large number of *Chirotoma* in the Lerma basin; no other river in North America indeed, has so large a proportion of its fishes belonging to a salt water¹ family. It is probable that this number will be considerably increased when this basin is more thoroughly explored. I had seen but a few specimens of *Chirotoma* before going to Mexico, and so never had an opportunity to study these fishes. And while I was careful to pick up specimens of all species, yet my unfamiliarity at that time with the group, no doubt, caused me to overlook some species. Again there is a number of small

¹The *Chirotoma* are the only fishes belonging to a salt water family found on the Mexican plateau.



Goodea luitpoldi (Steindachner), with ovary containing young.

isolated lakes which have never been visited. It is known that some of these lakes, as Patzcuaro and Zirahuén, have in them one or more characteristic species and no doubt most of them have. The Lerma river system is far from being thoroughly explored, but apparently its fish fauna is quite as distinct and characteristic as if it were an island in the sea.

All of the many beautiful lakes in this area, now isolated, evidently at one time drained into the Lerma, and so became stocked with fishes. It is often argued that fishes become established in isolated lakes by their eggs being carried accidentally by water birds. Although while these birds are feeding some eggs of fishes might cling to their feathers or legs and be taken to adjacent waters, yet I much doubt the dispersion of fishes in this way. Were this method of dispersion at all common fishes would surely have been found in Shoshone and Lewis lakes in the Yellowstone Park; moreover in the isolated lakes in the valley of the Lerma the viviparous fishes are about as evenly distributed as are the egg laying ones.

The Rio Balsas is one of the largest rivers in Mexico. It is southeast of the Lerma and drains about the same area; and though these two rivers are so near each other, not a single species is known to be common. But one species of the silverside and two of killifishes, are known from the Balsas, and yet these two families comprise nearly two thirds of the fishes of the Lerma basin. The Balsas is far from being thoroughly explored; enough, however, has been done to indicate the nature of its fauna and to indicate that it contains comparatively few species of fishes.

In Mexico there are four quite distinct fish faunas, and though they overlap at the borders, the map may fairly indicate where each fauna prevails.¹ The origin of these fish may be approximately given as follows: from the Colorado river 9, from the Rio Grande 80, from the Lerma 49, and from Central America about 108; total 246.

The fish fauna of northern Mexico is essentially that of the Rocky Mountains and eastern United States, or that part of the United States adjacent to Mexico. This eastern fauna has

¹ The fishes of the region marked unknown probably belong to the Rio Grande fauna.

crowded its way over the divide and has become even more firmly established in the Pacific coast streams of Sonora than has the Rocky Mountain fauna.

The South and Central American faunas prevail largely as far north as the City of Mexico. The few forms which extend farther north apparently keep to the lowland streams; especially is this true on the Pacific side. The most northern representative of the South American fauna, one of the Cichlids,¹ is found in Mazatlan. On the east coast this family has a representative in Texas. The fauna of the Lerma, the only river basin extensively studied, is quite distinct from either North or Central and South America. This fauna is richer and more characteristic than was formerly supposed.

Mexico in general is not a well watered country. Nearly all of the small streams and many of the large ones become much reduced in size by the end of the long dry season, and such streams never sustain a large number of species of fishes. On the Mexican plateau the largest and most important lakes are found in the Lerma basin; Lake Chapala, the largest and the only one which has a large river for outlet and inlet, sustains the largest fish fauna. Patzcuaro, a large lake with no inlet or outlet does not have so varied a fauna, but supports a large number of individuals. In view of the fact that more species of fishes belong to tropical Mexico than to a like area farther north it seems strange that a great river like the Balsas which lies wholly within the tropics should contain so few species. This river is fed by many mountain springs, and even in the dry season contains an abundance of clear water. Collections of fishes have been made at but three places in this river basin, and in all only 11² species of fishes taken, a number much fewer than one would expect.

¹ The name Mojarra is used for the Cichlids in Mexico, it is also much used on the plateau for the larger Poeciliidæ.

² *Istliarius balsanus* Jordan & Snyder, *Algansea salliei* (Günther), *Notropis nigrotentatus* (Günther), *Tetragonopterus mexicanus* Filippi, *Gambusia gracilis* Heckel, *Pacilia limantouri* Jordan & Snyder, *Chirostoma jordani* Woolman, *Melaniris balsanus* Meek, *Agonostomus nasutus* Günther, *Ileros istlanus* Jordan & Snyder, *Awaous taisiaca* (Lich.).

Algansea salliei and *Chirostoma jordani* are in my opinion wrongly ascribed in this river basin.

From many lakes and rivers in Mexico no collections of fishes have been made. In conclusion I will say that since the fish fauna of Mexico is far from being thoroughly explored, the faunal areas as I have outlined them, and their origin and probable lines of dispersion must be regarded as tentative.

FIELD COLUMBIAN MUSEUM.

Chicago, June, 1903.